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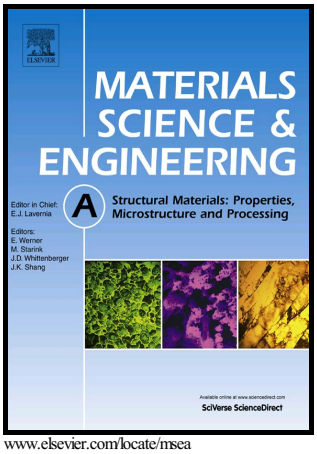

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Comparative study of commercially pure titanium produced by laser engineered net shaping, selective laser melting and casting processes

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Abstract: Commercially pure titanium was produced using laser engineered net shaping (LENS) and selective laser melting (SLM) processes. The SLM and LENS processing parameters as well as critical aspects including densification and balling effect were investigated. The resulting properties were studied and compared with those from traditional casting. Investigation of the processing parameters showed that significantly higher laser power and energy density is required in LENS compared to SLM in order to obtain near full density (99.5%). The microstructural investigations revealed an α microstructure with mixed morphologies including plate-like and widmanstätten for LENS somewhat similar to the serrated and fine acicular α obtained from casting. In contrast, the SLM samples showed only martensitic α′ phase mainly with a lath-type morphology. The difference between SLM and LENS microstructures was discussed based on interrelated aspects including energy density, solidification rate and specific point energy. Differences in their microstructures are mainly associated with differing rates of cooling and differing energy densities during SLM and LENS processing. Compression and hardness tests indicated that SLM titanium possesses better mechanical properties due to a fine grain size and martensitic phase composition, whereas LENS and cast titanium with α microstructures show similar mechanical properties.

Keywords: Commercially pure titanium; Laser engineered net shaping; Selective laser melting; Casting